

*Note implications/techniques for
large-scale integrated circuitry.*



CATHODE RAY TUBE INTEGRATED SUB-SYSTEMS

**Technical Bulletin
Precision Pattern Generator**

LITTON INDUSTRIES ELECTRON TUBE DIVISION, DISPLAY DEVICES AND EQUIPMENT DEPARTMENT



CATHODE RAY TUBE INTEGRATED SUB-SYSTEMS

Litton Industries Electron Tube Division is a major producer of high resolution cathode ray tubes and related driving equipment. As a logical outgrowth of these activities, we produce integrated sub-systems which provide systems manufacturers with complete information input/output assemblies. Litton tailors integrated sub-systems to meet individual requirements.

This interaction of CRT and equipment technology resolves interface problems and results in a more reliable end product. All the components included in these sub-systems are matched to perform together with maximum effectiveness and are designed to complement the capabilities of the high resolution cathode ray tube included in the system.

Model 1072 Precision Pattern Generator

An outstanding example of the cathode ray tube (CRT) integrated sub-systems produced at Litton is the Model 1072 Precision Pattern Generator. The Model 1072 is currently in use for the computer controlled generation of interconnect masks required in the production of large scale integrated circuit arrays.

The Model 1072 employs a high resolution cathode ray tube and an electronic control system to achieve a degree of speed, accuracy, resolution and repeatability never before attained in recording systems. It has the

ability to lay out a pattern of accurately spaced, uniform lines 25 microns wide, without blemishes or breaks, in less than a second under computer control.

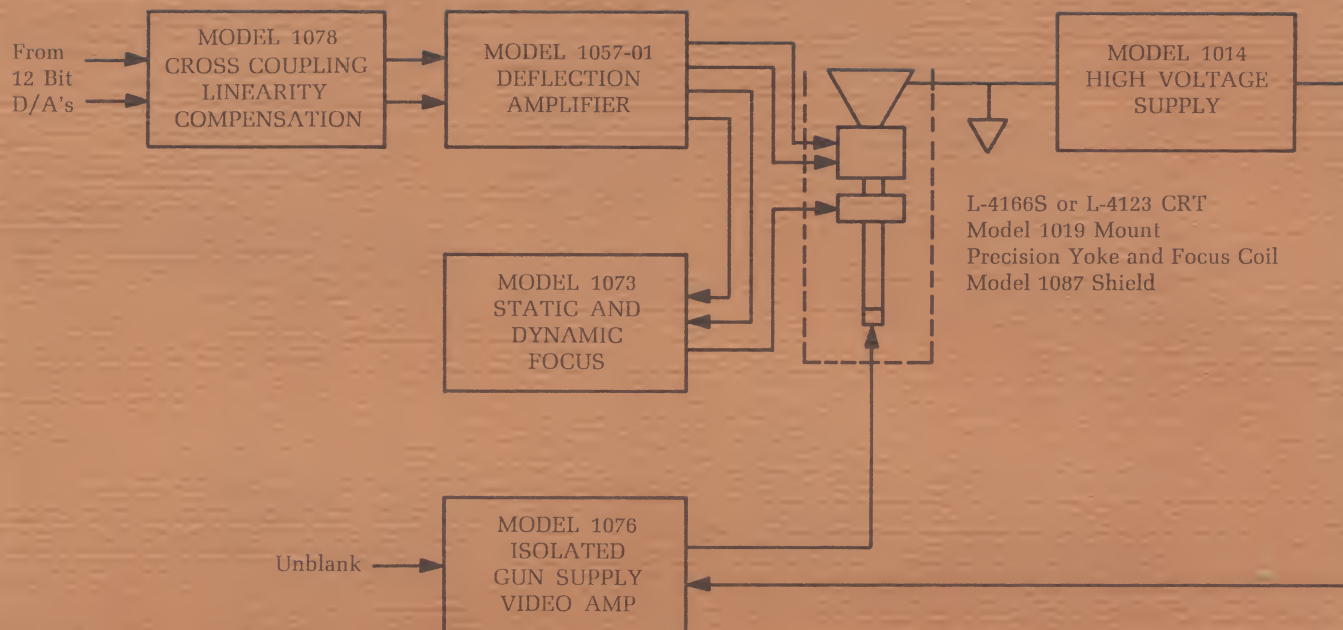
The CRT was chosen as a light source for this system because of its speed and versatility and because Litton's special phosphor deposition techniques virtually eliminate problems caused by phosphor screen blemishes.

Since the CRT and the electronic components are produced and integrated at the same location, a uniquely aligned beam results which greatly enhances the display symmetry. To achieve accuracy and stability of the electron beam position, a new deflection system has been designed which utilizes a special cross coupling sine/tangent correction module. State-of-the-art deflection and focus components are also included.

In addition, the focus system automatically follows the electron spot position to provide proper correction anywhere on the CRT face, in a smooth dc coupled fashion. The entire system is dc coupled and non-frequency sensitive within the range of the deflection amplifier. Because of this, the beam can be stepped or swept slowly or at high speed, with simple or complex waveforms.

The versatility of this sub-system may be enhanced by only slight modifications to the basic design. For instance, by using a P16 phosphor* and adding a photo-sensing device, the system becomes a highly accurate,

*The Litton cathode ray tube employed in this system is available with P11, P16, P24 or any of the standard phosphors.



Model 1072 Precision Pattern Generator

computer controlled scanner. Use of a P24 phosphor and suitable separation filters permits color scanning.

Pattern Generator Components

The basic components of the pattern generator are shown in the block diagram above. The deflection amplifiers convert input voltage levels, received from digital to analog converters, to current flow through the deflection coil. There is one amplifier for the X coil winding and one for the Y coil winding. Current flow through the coil windings deflects, or positions, the beam on the cathode ray tube face. The linearity corrector compensates for spot position error caused by the geometry of a flat faced CRT and its electromagnetically deflected beam.

The focus supply provides current for the static focus coil winding which, in turn, converges the electron beam to a finely focused spot on the CRT phosphor screen. Another portion of the focus supply changes the current, through an auxiliary focus coil winding, to correct the focus as a function of spot placement on the tube face. In this manner, a constant spot size is maintained no matter where the spot is deflected on the tube face.

The electron gun supply video (or unblanking) amplifier provides all the power for the electron gun and, in addition, amplifies incoming low level signals for application to the cathode ray tube electron beam control grid to turn the beam on and off.

The high voltage supply furnishes electron beam final accelerating voltage.

All of the equipment described above must perform in an extremely precise and stable manner in order to achieve the accuracy required for the generation of integrated circuit interconnections.

Function of the Pattern Generator

The Model 1072 is a precision component in a system used for the computer controlled generation of interconnect masks for large scale integrated circuit arrays.

The process begins with the examination of an IC chip by a computer controlled probe. This probe locates the usable and unusable cells and relays the information to a computer which formulates an interconnection pattern. The computer output is then fed into a system which includes the Model 1072, and the electrical signal is converted into light on the CRT faceplate.

Under the control of the computer generated interconnection program, the CRT exposes the interconnect lines onto photographic film with an accuracy to 1 part in 10,000. The exposed film is then processed and the resulting negative becomes the interconnect mask used to produce integrated circuits.

With this method, masks have been produced at speeds 10 times as fast as was possible with previous methods.

Other CRT Integrated Sub-Systems

Other applications for CRT Sub-systems such as the Precision Pattern Generator include:

- Curve tracing under computer control
- Scanning of atomic particle tracks
- Digital picture recording
- Picture digitizing
- Densitometry
- Side looking radar processing and recording
- Satellite picture recording
- Scanning for photo-interpretation
- Document storage and retrieval
- Infra-red recording

The sub-systems described in this brochure and listed above are just a sampling of our capabilities. We invite you to contact us to discuss your particular requirements. We would welcome the opportunity to show you how a Litton CRT sub-system can benefit your system.

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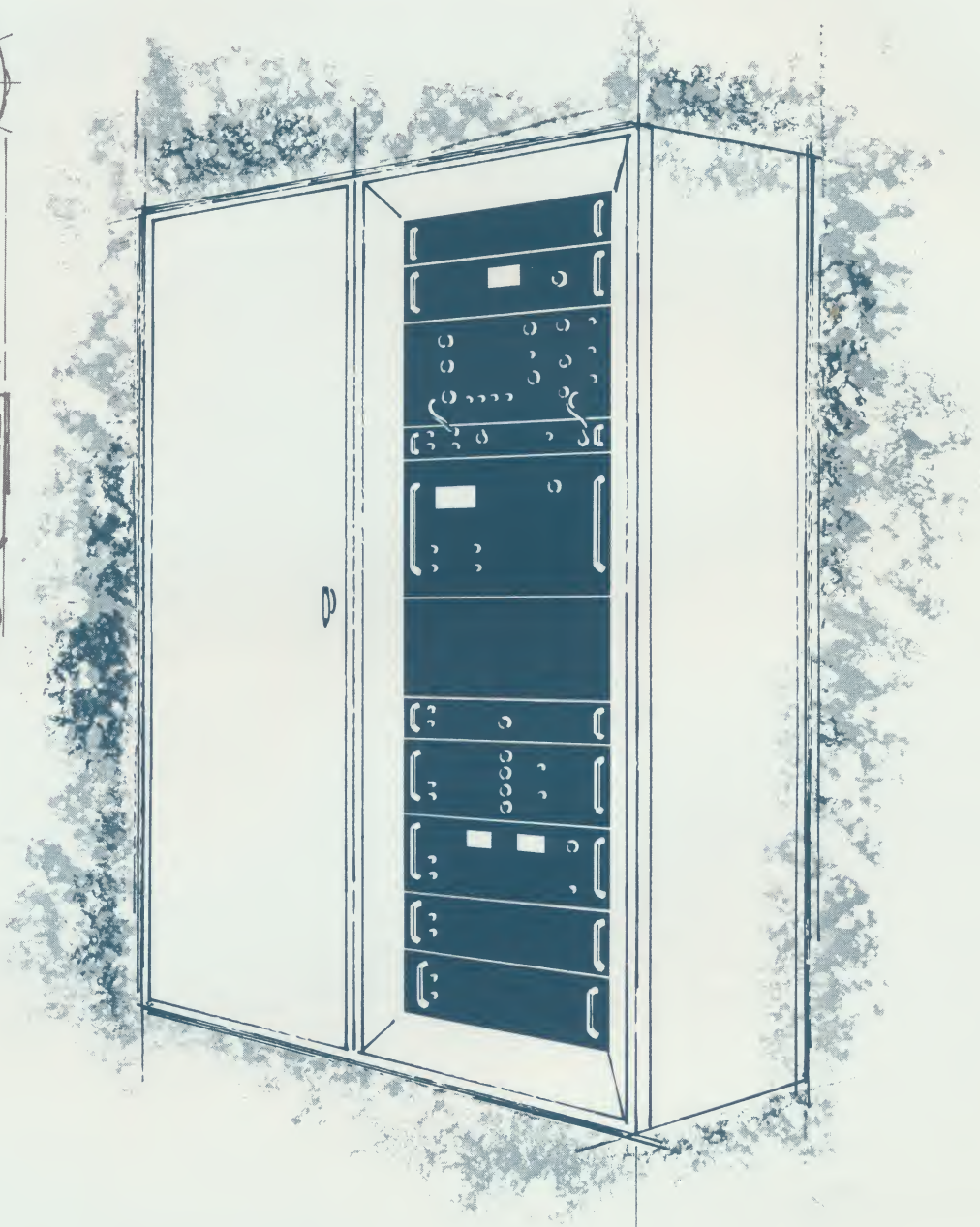
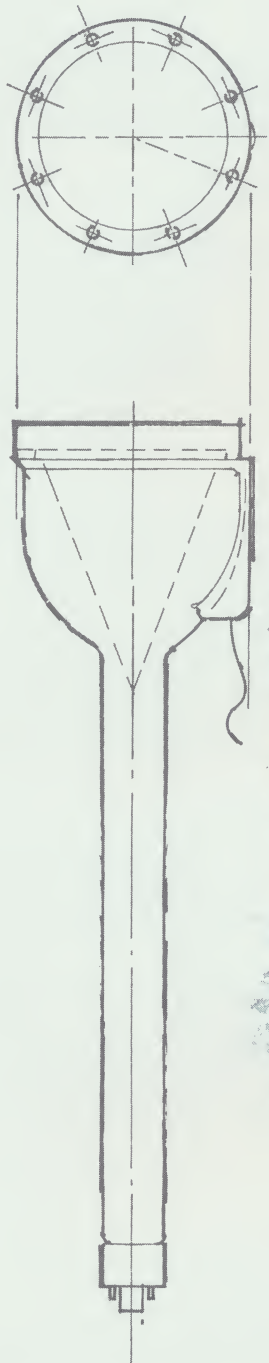
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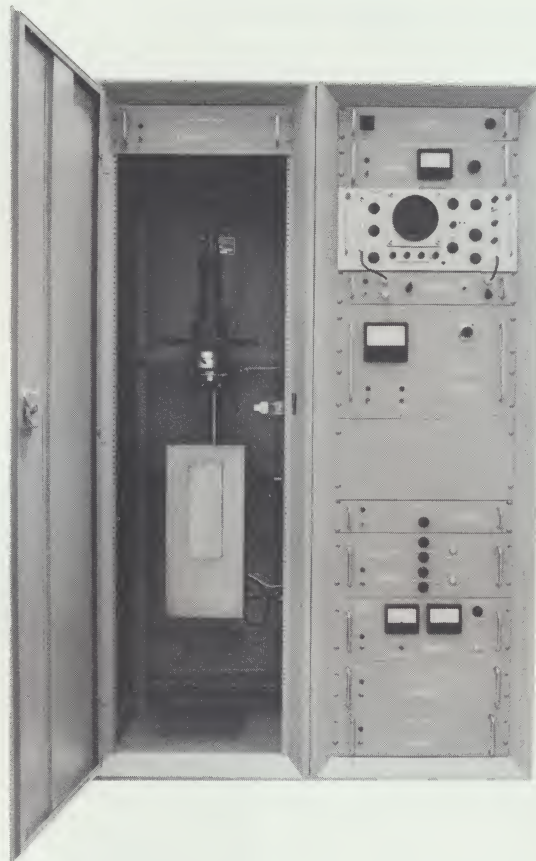
LITTON INDUSTRIES ELECTRON TUBE DIVISION



FLYING SPOT SCANNERS AND RECORDING SYSTEMS

TECHNICAL BULLETIN

LITTON INDUSTRIES ELECTRON TUBE DIVISION, DISPLAY DEVICES AND EQUIPMENT DEPARTMENT



FLYING SPOT SCANNERS AND RECORDING SYSTEMS

A flying spot scanner is one of several methods of converting an image into electrical signals. It is a type of electronic camera. Flying spot scanners are most often specified for viewing two dimensional subject matter such as film transparencies or document pages. For these applications, the flying spot scanner offers a number of advantages over conventional camera systems, including:

- higher resolution
- less picture shading
- higher versatility in scan modes

The scanner output signal may be employed in a number of ways, including; signal processing to enhance certain picture properties, narrow band image transmission where the picture is scanned under discrete control, entry of information into a document storage and retrieval system, transmission of information to a remote point, or data reduction where images are scanned under computer control for data processing by a computer.

At some point, most of the above uses require the conversion of the electrical signal back into images. This is performed by the scanner system as a recording function. Other recording uses include high-speed computer read-out, and strip mapping using radar or infra-red scanning output signals.

Scanning Modes and Recording

The basic scanning or recording process involves the movement of a small point of light over a subject. Scanning by this point of light can take one of several forms. A *TV type scan* is accomplished by programing the scanning spot to proceed from the top of the subject to the bottom in a series of lateral excursions that essentially cover the entire subject area. In *random scans*, the light beam is directed onto the subject in

sequence to predetermined coordinates. *Single line scans* are used for recording strip maps where a length of film moves continuously or in small steps at right angles to the image scan line.

For scanning transparencies, a phototube is placed on the opposite side of the transparency from the light source. This tube will read instantaneous density, the output being an electrical signal level. For document scanning, a phototube is positioned to pick up reflected light. If the intensity of the scanning point of light is held constant, the density of each point on the subject can be read in a programed or controlled manner.

When the scanner is used as a recorder, a piece of unexposed film is placed in the position of the subject, and, by controlling the intensity of the point of light as it moves, a picture can be exposed on the film. The only difference between a scanner and a recorder is the presence of a photo pick-up in a scanner. *Thus, one system can serve for both scanning and recording.*

Scanning Light Sources

It is possible to make a scanner or recorder by mechanically deflecting a light beam, however, this method is relatively slow and has the usual maintenance problems of a mechanical device. Modulating the light beam at high frequency for recording is also a problem with this method. The high resolution cathode ray tube (CRT) with a uniform fast decaying phosphor screen, as employed in a Litton system, makes a superior scanning light source. A CRT is fast, all electronic, and is easily controlled by a computer. Color transparencies may be scanned by using a CRT phosphor having a broad output spectrum, along with three phototubes and suitable color separation optics.

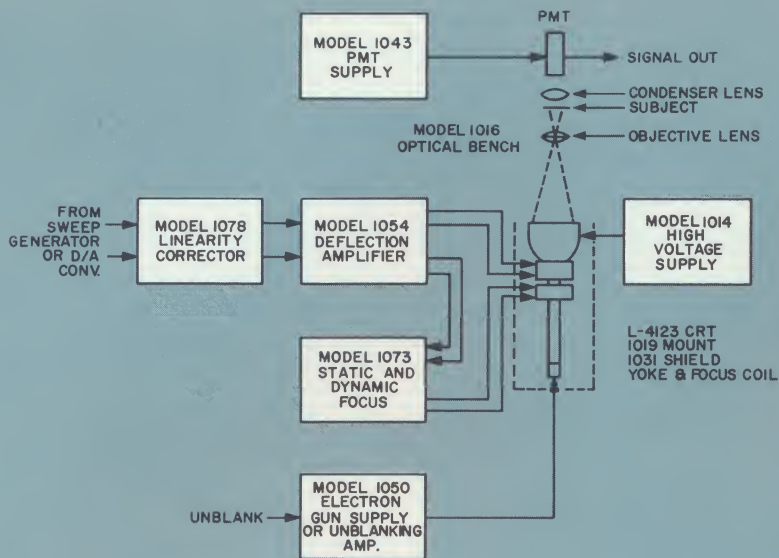


FIGURE 1—FLYING SPOT SCANNER SYSTEM

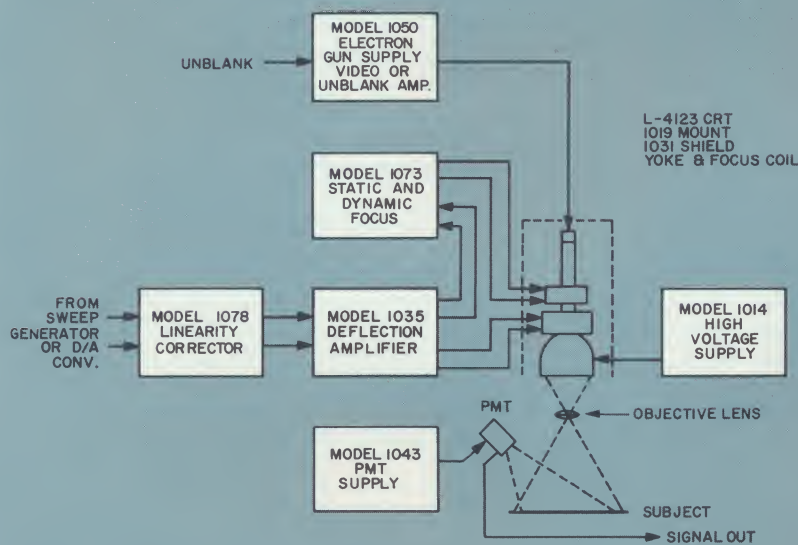


FIGURE 2—OPAQUE DOCUMENT SCANNING SYSTEM

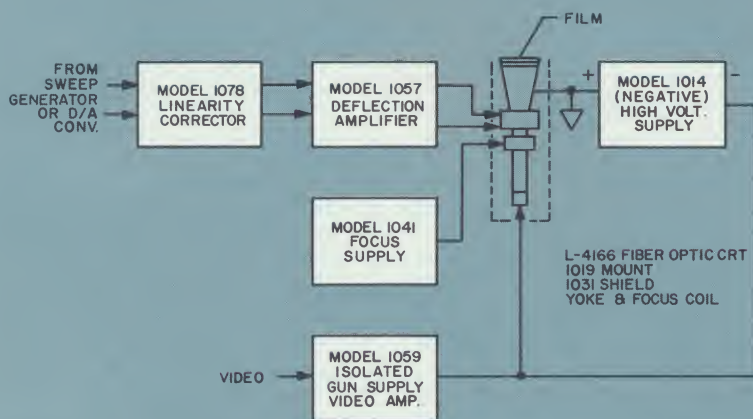


FIGURE 3—FIBER OPTIC CRT RECORDER

Applications

Typical Litton CRT high resolution scanning and recording applications include:

- Side looking radar processing and recording
- Atomic particle track scanning
- Document scanning
- Inspection of film recordings
- Satellite picture recording
- Infra-red recording
- Cell counting
- Densitometry
- Film based large screen displays
- Scanning for simulators, radar land mass, earth scene, etc.
- Scanning for photo-interpretation
- Character recognition
- TV scanning
- Video recording
- Computer controlled scanning and recording
- Document storage and retrieval
- Airborne scanning of reconnaissance film

Scanner Construction

All cathode ray tube systems have certain basic components for holding, powering, and controlling the CRT. These are:

1. The CRT itself
2. Mechanical mounting and optics
3. The high voltage supply
4. Deflection amplifier and coil
5. Focus supply (and coil if required)
6. Electron gun supply/video (or unblanking) amplifier
7. In case of a scanner, the phototube and supply

With these major building blocks, all that is required for operation, is the X and Y beam position input signal (or sweeps) and electron beam off or on level signal (video for recording; unblanking for scanning).

Typical Systems

Figure 1 shows a simplified block diagram of a scanning system, indicating the Litton model numbers for the various components.

Figure 2 shows a simplified mechanical rearrangement for document or reflection scanning.

Figure 3 is a block diagram of a fiber optic recorder for a dry process film.

Choices of tube types, deflection amplifiers, etc., will depend on the application. Lists of standard components, data sheets and application notes are available on request.

Specifications

The following important specifications must be considered when planning a scanner or recorder system:

1. Spot size required at the film or subject matter plane
2. Film size and/or area to be scanned
3. Type of scanning (TV, computer controlled, etc.)
4. Beam position time or sweep frequency
5. Beam position accuracy (linearity)
6. Size or weight limitations
7. Environmental requirements
8. Film transport requirements
9. Input characteristics

A typical scanner might be planned as follows:

1. Spot Size—0.0007"
2. Film Size—70 mm
3. Input—Computer Control (Digital to analog converters used as inputs to the deflection amplifier)
4. Positioning Time—12 microseconds for longest excursion (from one side of the transparency to the other)
5. Positioning Accuracy—0.1%
6. Bandwidth (for TV scans) 20 Mc
7. Mounting—Rack Mounted
8. Environment—Laboratory

Available Components

Cathode Ray Tubes

High resolution with .0008" spot or better; Fiber optic types; low deflection angle; ruggedized; scanning or recording.

High Voltage Supplies

15 to 40 KV; Positive or negative; airborne optional.

Deflection Amplifiers

6 amps peak to peak to 36 amps peak to peak; Linearity correction optional.

Focus Supplies

Static supplies; dc coupled, automatic dynamic focus circuits.

Electron Gun Supplies and Amplifiers

For video, dc to 20 Mc., or unblanking, dc coupled. Also isolated versions for fiber optic tubes.

Photo Sensing Equipment

PMT assemblies; Highly regulated PMT supplies.

Mechanical Assemblies

Precision mounts; Optical benches; Magnetic shields.

Complete System or Components

Litton is your best single source for flying spot scanner equipment, whether you need a complete scanner system, or individual components. As a supplier of both cathode ray tubes and equipment, the Electron Tube Division can provide performance matched components that are necessary to meet high resolution requirements.

Additionally, we can combine these building blocks to produce the finest compatible systems that minimize procurement and interface problems while delivering maximum reliability and performance.

We invite you to contact us for further information or engineering assistance.

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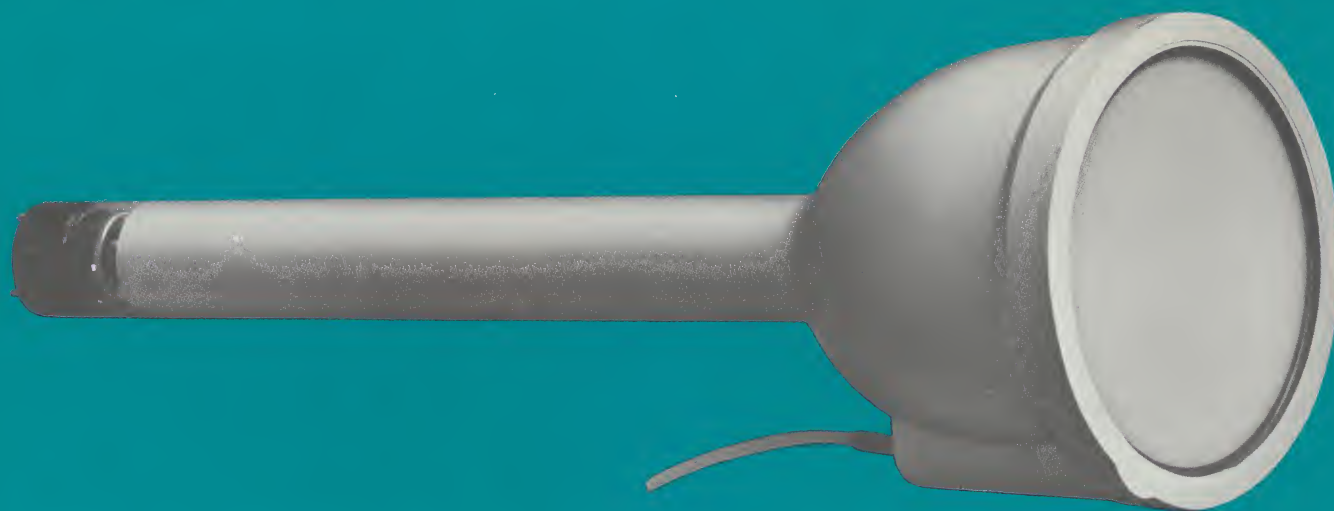
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LITTON INDUSTRIES ELECTRON TUBE DIVISION



LITTON HIGH PERFORMANCE CATHODE RAY TUBE SUMMARY

Detailed specifications are given on individual data sheets where available. All Screens Metalized. All Anode Voltages 25 kv unless otherwise specified. "A" Gun—Medium High Resolution; High Current "S" Gun—High Resolution

Electro-magnetic Deflection and Focus Flat Face for Recording and Scanning (yellow sheets)

Size	Screen Shape	Gun Type	Deflection Angle	Mounting	Special Characteristics	Special Characteristics	Spot Size	Type Number
2"	Rect.	"S"	45°		Miniature	7/8" Neck; 12 kv	.0009	L-4103
5"	Round	"A"	40°	Machined	Ruggedized	Aligned Gun	.0012	L-4106
5"	Round	"A"	40°				.0012	L-4108
5"	Round	"A"	40°		Spec. P24 Phosphor		.0013	L-4119
5"	Round	"A"	40°	Machined			.0012	L-4120
5"	Round	"A"	40°		Dual Deflection		.0015	L-4121
5"	Round	"S"	40°	Machined			.0008	L-4110
5"	Round	"S"	40°		Ruggedized	Flying Leads	.001	L-4114
5"	Round	"S"	40°	Machined	Precision Neck		.0008	L-4118
5"	Round	"S"	40°				.0008	L-4123
5"	Round	"S"	40°		Dual Deflection		.0012	L-4147
5"	Round	"S"	24°				.0015	L-4125
5"	Round	"S"	16°				.002	L-4200
7"	Round	"A"	40°				.0015	L-4197
7"	Round	"S"	40°				.0009	L-4104
9"	Round	"A"	52°		7" Sub-Mounted Screen		.002	L-4209
9"	Round	"S"	40°				.0011	L-4192
9"	Round	"S"	52°				.001	L-4210

LITTON INDUSTRIES, ELECTRON TUBE DIVISION, DISPLAY DEVICES AND EQUIPMENT DEPARTMENT

Electro-magnetic Deflection and Focus

Fiber Optic Types (blue sheets)

Available in a range of N. A. and fiber sizes. Special options such as coatings and shapes available. Anode voltages up to 40 kv on some types.

Size	Shape	Screen Dimensions	Gun Type	Deflection Angle	Special Characteristics	Special Characteristics	Spot Size	Type Number
1"	Square	1" sq.	"A"				.0012	L-4141
2"	Square	1 $\frac{5}{8}$ " sq.	"A"	40°			.0012	L-4142
2"	Round	1 $\frac{5}{8}$ " dia.	"A"	40°	Spherical Inside Face	High Output P16	.002	L-4188
2 $\frac{1}{2}$ "	Square	2 $\frac{1}{4}$ " sq.	"A"	30°			.0012	L-4166
3"	Line scan	2 $\frac{7}{16}$ " x $\frac{3}{16}$ "	"A"	36°	Cylindrical Outside Face		.0012	L-4216
3 $\frac{1}{2}$ "	Round	3 $\frac{3}{16}$ " dia.	"A"	30°	Spherical Inside Face		.0012	L-4198
5"	Round	4 $\frac{1}{4}$ " dia.	"A"	40°			.0012	L-4221
8 $\frac{1}{2}$ "	Line scan	8 $\frac{1}{4}$ " x $\frac{3}{16}$ "	"A"	55°			.0015	L-4167
9 $\frac{1}{4}$ "	Line scan	9 $\frac{1}{4}$ " x $\frac{3}{16}$ "	"A"	60°			.0015	L-4186
3"	Line scan	2 $\frac{7}{16}$ " x $\frac{3}{16}$ "	"S"	36°	Cylindrical Outside Face		.0008	L-4196
5"	Line scan	4 $\frac{3}{8}$ " x $\frac{3}{8}$ "	"S"	40°			.0008	L-4183
5"	Round	4 $\frac{1}{4}$ " dia.	"S"	40°			.0008	L-4199
5"	Round	4 $\frac{1}{4}$ " dia.	"S"	24°			.0015	L-4201
8 $\frac{1}{2}$ "	Line scan	8 $\frac{1}{4}$ " x $\frac{3}{16}$ "	ES	55°	Electrostatic Focus		.003	L-4190
5"	Line scan	4 $\frac{3}{8}$ " x $\frac{3}{8}$ "	"S"	40°	Packaged & Potted with Coils		.0008	M-1060

Electro-magnetic Deflection Electrostatic Focus

Flat Face for Recording and Scanning (yellow sheets)

Size	Shape	Screen Dimensions	Deflection Angle	Mounting	Special Characteristics	Special Characteristics	Spot Size	Type Number
5"	Round	4 $\frac{1}{4}$ " dia.	40°				.001	L-4146
9"	Round	7" dia.	52°		Sub-Mounted Screen		.003	L-4182
8 $\frac{1}{2}$ "	Line Scan	8 $\frac{1}{4}$ " x $\frac{3}{16}$ "	55°		Fiber Optic (Blue Sheet)		.003	L-4190
5"	Round	4 $\frac{1}{4}$ " dia.	40°		Fiber Optic; Spherical Inside Face		.001	L-4224

Electro-magnetic Deflection and Focus

Large Screen for Direct View (yellow sheets)

Size	Screen Shape	Gun Type	Deflection Angle	Special Characteristics	Special Characteristics	Spot Size	Type Number
14"	Rect.	"A"	90°			.003	L-4155
17"	Rect.	"A"	90°			.004	L-4189
19"	Rect.	"A"	90°			.004	L-4156
21"	Rect.	"A"	90°			.005	L-4129
21"	Rect.	"A"	90°	Dual Deflection		.006	L-4105

Electro-magnetic Deflection and Focus

Direct Electrostatic Writing (PRINTAPIX®) Tubes (orange sheets) Single Line Scan

Size	Useful Width	Deflection Angle	Elements per inch	Special Characteristics	Resolution (on paper)	Type Number
3"	2 $\frac{3}{4}$ "	40°	1000		.003"	L-4134
5"	5"	44°	350		.005"	L-4159
8 $\frac{1}{2}$ "	8 $\frac{1}{2}$ "	53°	500		.007"	L-4101

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DRIVING & ACCESSORY EQUIPMENT FOR LITTON DISPLAY DEVICES

GRAY
SHEETS

High Voltage Supplies, Accessories

Model 1014	20 to 30 kv positive or negative output
Model 1044	Airborne Supply, minimum volume and weight
Model 1045	Airborne High Voltage Module only
Model 1046	Same as 1014 only up to 40 kv; range switching option down to 17 kv
Model 1022	High Voltage Connector, tank wall mount
Model 1051	High Voltage Connector, in line

Deflection (all amplifiers with dc supplies)

Model 1015	TV Raster Generator
Model 1035	12 amp p to p, 2 axis, unbalanced, rack mounted
Model 1054	12 amp p to p, 2 axis, balanced, rack mounted
Model 1057	6 amp p to p, 2 axis, balanced, rack mounted
Model 1057-01	4 amp p to p, 2 axis, precision, rack mounted
Model 1057-03	6 amp p to p, one axis, no mounting
Model 1069	36 amp p to p, 2 axis
Model 1078	Two axis, cross coupling Linearity Corrector
Gain and centering for deflection-amplifiers	
Single axis linearity correction circuits	

Focusing

Model 1008	Static Focus Supply for coils such as Syntronic F20B and CELCO AF 334-200
Model 1041	Static Focus Supply for higher resolution applications, coils such as CELCO HF 334-379 static winding
Model 1073	Static and dc coupled dynamic focus correction, coils such as CELCO HF 334-379/560

Conventional Electron Gun Supply / Video Amplifiers

Model 1050	Gun Supply and dc coupled video amplifier 4.5 MHz Bandwidth, 10 MHz special order
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Isolated Electron Gun Supply / Video Amplifiers

Model 1059	Gun Supply Video Amp dc restored, rf coupled, G2 voltage to 450 volts, 10 MHz bandwidth
Model 1065	Gun Supply Video Amp dc restored for two level repetitive operation, rf coupled, G2 voltage to 450 volts
Model 1067	Same as 1059 except deep chassis to provide extra unused room on isolated chassis
Model 1067-01	Light coupled, dc coupled, two level signal, Gun Supply Video Amp, 2000 volt G2 supply
Model 1067-02	dc coupled Gun Supply Video Amp, rf coupling, G2 voltage range 500 to 2000 volts, 4 MHz bandwidth
Model 1086	Airborne, sealed, solid state gun supply video amp, light coupled 2000 volt G2, 3.5 MHz bandwidth

Mechanical Assemblies—Tube Mounts, Scanner Assemblies, Shielding

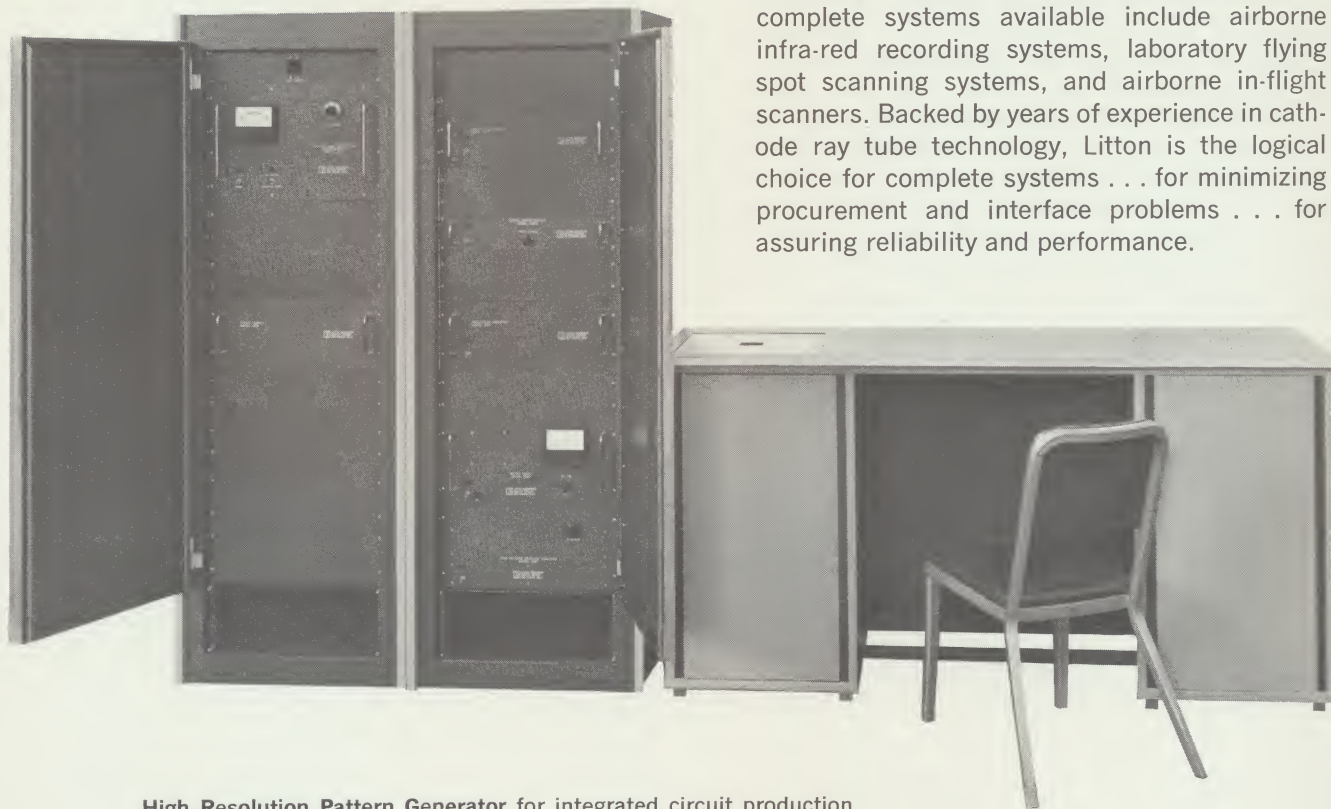
Model 1016	Optical Bench Assembly turret type, 8, 2 x 2 mounts
Model 1068	(1016A) Enlarger Type Optical Bench Assembly
Model 1018	Cathode Ray Tube Mount (spherical joint component holders)
Model 1019	Cathode Ray Tube Mount, Separate X, Y, pitch, yaw adjustment Available for most CRT's including other manufacturers'
Model 1031	Magnetic Shield for 5" tube/mount assemblies
Model 1070	Magnetic Shield for 7" tube/mount assemblies
Model 1087	High Attenuation Magnetic Shield for precision displays

Photo Sensing Equipment for Scanners

Model 1043	PMT Supply with PMT in shielded housing
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COMPLETE SYSTEMS

In addition to producing a complete line of high resolution cathode ray tubes and related equipment, the Display Devices and Equipment Department develops, and manufactures complete systems for high performance scanning, recording and display applications. Examples of complete systems available include airborne infra-red recording systems, laboratory flying spot scanning systems, and airborne in-flight scanners. Backed by years of experience in cathode ray tube technology, Litton is the logical choice for complete systems . . . for minimizing procurement and interface problems . . . for assuring reliability and performance.



High Resolution Pattern Generator for integrated circuit production

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